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Flat Plate Membrane Installation Update
from
Enviroquip / Kubota

Attached are single page case studies on **(4) Wastewater Plants** utilizing the Flat Plate Membrane –

Tulalip Tribes, WA	1.25 mgd
Bandon Dunes, OR	125,000 gpd
Running Springs, CA	600,000 gpd
McKinney Roughs, TX	25,000 gpd.

All four plants are designed for gravity operation (no permeate pumping).

The pilot plant in **Duvall, WA** has been operating for 5 months. We would like to thank the more than 200 people who came out to see it during that time. This unit will be moving to **King County's Westpoint Facility** next week for 6 months of testing.

The **City of San Diego** has begun testing the Enviroquip / Kubota Flat Plate Membrane system at their Point Loma facility. **Montgomery Watson** is managing this project for **Title 22** approval.

Los Angeles County is scheduled to start up in June, 2002.

Jackson County, OH is scheduled to start up in June, 2002.

Remember..... the Flat Plate Membrane was developed specifically for wastewater applications and requires the least amount of operator attention. It was not adapted from water treatment like other membranes. Low maintenance has been proven at over **700 wastewater plants** currently in operation – the most of any membrane.

For more information please call Treatment Equipment Company at **800-454-4306** or visit Enviroquip's web site at **www.enviroquip.com**.

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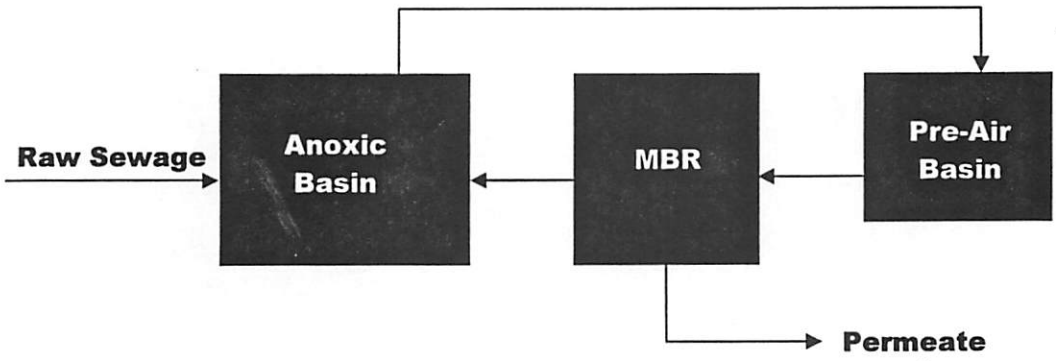
CASE STUDY— Bandon Dunes Resort



Enviroquip MBR Treats Resort Wastewater in Oregon

The owners of the Bandon Dunes Resort, a premier golf facility on the coast of Southern Oregon, are expanding existing clubhouse facilities and adding overnight lodges. The expansion could eventually increase facility wastewater flow from a permitted limit of 22,500 gallons per day (gpd) to an estimated average daily flow of 250,000 gpd. To treat the increased wastewater flows and address strict nitrate limits, the owners contracted with the Dyer Partnership, Inc. to design a membrane bioreactor (MBR) plant.

In January of 2002, Enviroquip was selected to provide all of the MBR equipment, instrumentation, and technical support services necessary to upgrade the Bandon Dunes Wastewater Treatment Plant (WWTP). Currently under construction, the MBR plant is scheduled to be online by May of 2002.

Enviroquip's MBR equipment was chosen for its small footprint, low maintenance, simple operation and superior effluent quality. Designed to treat 125,000 gpd, the footprint of the new plant will be approximately 13' by 54' and will include anoxic, pre-aeration, and MBR basins. By operating the MBR at an average mixed liquor suspended solids (MLSS concentration of 15,000 mg/l, the plant will be able to treat influent concentrations of up to 70 mg/l nitrogen and more than 300 mg/l BOD. With the exception of solids handling, the MBR plant will operate virtually unattended. In addition, maintenance personnel will only be required to clean MBR membranes once every six months. The biannual cleanings will be performed in place using a dilute bleach solution and take less than two hours to complete.

Raw wastewater will be pumped into the anoxic basin, mixed with activated sludge and the sludge pumped into the pre-air basin. Aerated sludge will then overflow into the gravity operated MBR for microfiltration. From the MBR, filtered water will drain into a chlorine contact chamber and concentrated activated sludge will overflow into the anoxic basin—completing the recycle loop.

Disinfected effluent will be stored and utilized for course irrigation. MBR plant effluent will typically contain non-detectable amounts of suspended solids, less than 8 mg/l total nitrogen and less than 5 mg/l BOD. The new MBR WWTP will provide an easy-to-operate facility that will ensure permit compliance and preserve the natural beauty of the Bandon Dunes Resort.

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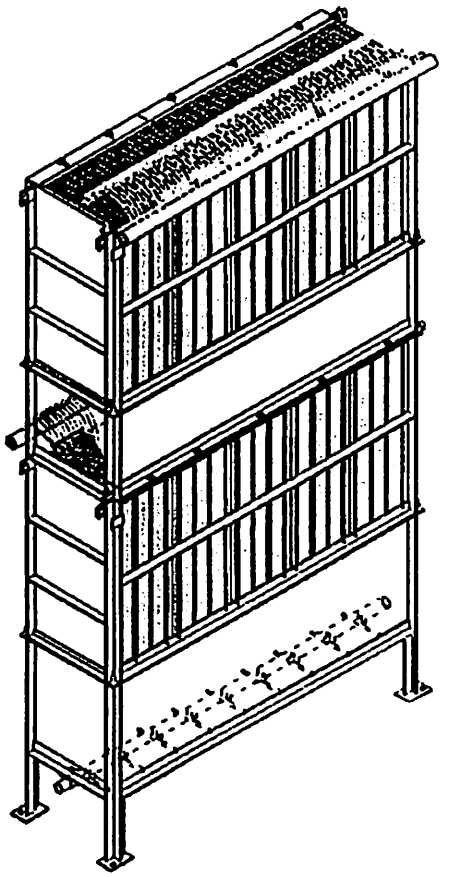
CASE STUDY— Tulalip, WA

Beneficial Reuse of Effluent from Casino WWTP



The Tulalip Tribes of Washington have selected Enviroquip membrane bioreactor (MBR) technology to treat wastewater from a new business park development in Tulalip, WA. The initial phase of the new development will include a casino, several commercial businesses, office space, a shopping center, and even a theme park.

Several wastewater treatment options were investigated, including co-treatment at the City of Marysville WWTP, and the upgrade of an existing oxidation ditch near the site, before The Tribes decided to construct a new dedicated wastewater treatment facility for the business park. However, officials from the Tribe and their consultant, Parametrix, concluded that Enviroquip's MBR process was particularly attractive due to its small footprint and ability to produce reuse-quality effluent.

It is anticipated that the effluent from the new MBR plant will eventually be utilized to irrigate landscaped areas around the new development, recharge local groundwater resources, and to increase the flow of several local salmon streams during low flow periods. In England and the US, Tulalip officials visited several full-scale municipal wastewater treatment facilities employing different membrane technologies, before choosing the Enviroquip MBR process. The Enviroquip MBR process was selected over other membrane systems due to the low maintenance required, simplicity of the process and the overall ease of operation. The contract was awarded in September 2001 and the facility is scheduled to be operational by January 2003.

The Enviroquip MBR at the Tulalip site will utilize Kubota's new double-deck membrane units to further reduce the footprint of the overall plant and thus help the WWTP to blend into its surroundings.

The Tulalip facility has been designed to handle an average flow of 1.25 MGD and a peak flow of 2.5 MGD. The raw wastewater characteristics are estimated at 400 mg/l BOD and 400 mg/l TSS, while the effluent from the new facility will exceed the strict effluent requirements of <5 mg/l BOD, <5 mg/l TSS, and <8 mg/l TN.

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CASE STUDY— Running Springs, CA

Running Springs Adds Nutrient Removal with MBR and SymBio®

The Running Springs, California, County Water District (RSCWD) currently operates a wastewater treatment plant (WWTP) that discharges to subsurface infiltration ponds and a small stream on local US Forest Service land. The District's current NPDES permit will soon expire and the new permit will include strict limits on nitrogen and phosphorous.

To meet new permit requirements and reduce energy costs, the RSCWD initially considered simultaneous nitrification and denitrification utilizing Enviroquip's patented SymBio® process.

However, due to a low average winter wastewater temperature of 10°C, it was determined that there is insufficient existing onsite tankage to provide the level of nitrogen removal required. The focus then shifted to ways to increase the solids retention time (SRT) of the existing activated sludge process at the plant, in order to ensure complete nitrification.

Conversion of the plant to a Membrane Bioreactor (MBR) process, a modification of the activated sludge process that operates at high mixed liquor concentrations and long SRTs, was one of the options proposed. Officials from the RSCWD requested proposals from several membrane technology vendors and then toured several operating facilities in the US and England. After observing several full-scale installations employing different membrane technologies, the RSCWD selected the Enviroquip MBR system for their plant upgrade, due to its high performance, low maintenance and ease of operation.

The upgrade was awarded as a complete turn-key project, and includes conversion of two existing aeration basins into Enviroquip MBRs and two existing clarifiers into an equalization tank and an anoxic basin. The equalization and anoxic basins will be able operate in a simultaneous nitrification/denitrification mode using SymBio® technology. New screening and ultraviolet disinfection will also be added to the facility.

Currently under construction, the upgraded Running Springs facility is scheduled to be operational by late-summer 2002.

The MBR/BNR facility has been designed to treat 600,000 gpd with the following characteristics: 260 mg/l BOD, 300 mg/l TSS, 36 mg/l TN and 8 mg/l TP. The plant is guaranteed to produce an effluent quality of less than 5 mg/l BOD, less than 5 mg/L TIN, less than 2 mg/l PO_4-P and less than 0.4 NTU turbidity.

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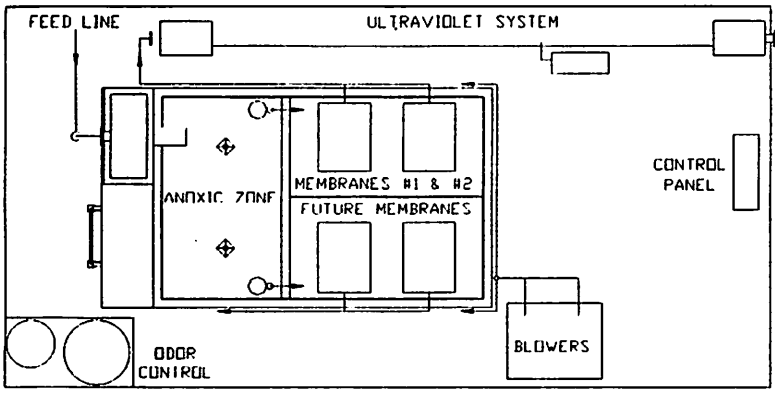
CASE STUDY— McKinney Roughs, TX

MBR Package Plant Treats Wastewater at Texas Nature Preserve



A new Enviroquip MBR package plant is currently under construction at McKinney Roughs, a 1,600-acre nature preserve in Bastrop County. The Lower Colorado River Authority (LCRA) operates an Environmental Learning Center (ELC) at McKinney Roughs. Currently, the ELC consists of two administrative buildings, which produce a total wastewater flow of 1,000 gallons per day (gpd). The LCRA is in the process of adding a dining hall and dormitories that will increase the wastewater flows to about 10,000-gpd. In addition, another 40,000 gpd of wastewater capacity may be required for potential commercial developments, for a total of 50,000 gpd.

To treat the increased wastewater flows and meet tight effluent limits of 5mg/L Biochemical Oxygen Demand (BOD), 5mg/L Total Suspended Solids (TSS), 2mg/L Ammonia-Nitrogen (NH_3), and 1mg/L Total Phosphorus (TP), membrane bioreactor (MBR) technology was selected as the desired treatment process. In November 2001, Enviroquip, Inc. was selected as the MBR technology vendor, and supplied all of the MBR equipment, instrumentation, and technical support necessary to satisfy the LCRA's needs at McKinney Roughs. Currently under construction, the MBR plant is scheduled to be operational by May 2002. The dormitories will be completed by July 2002.

Enviroquip's MBR equipment was selected for its superior effluent quality, small footprint, low maintenance, simple operation, and its flexibility for plant expansion. Initially designed to treat 10,000 gpd of wastewater, the overall plant is hydraulically designed for 25,000 gpd. The footprint of the new plant will be approximately 15 ft. by 30ft., and will include anoxic, pre-aeration, and MBR basins. Membranes will be added as required to expand treatment capacity up to 25,000 gpd.

The MBR treatment process is a form of activated sludge treatment employing long sludge ages and high mixed liquor concentrations, which reduce the amount of waste sludge produced. The membrane separation system removes TSS substantially, eliminating the need for two additional treatment units: clarification and filtration. With the exception of solids handling and biannual membrane cleaning, the MBR plant will operate virtually unattended.

The MBR effluent will be discharged to an unnamed, intermittent tributary of the Colorado River. The high quality of the MBR effluent will help to minimize the impact of this new development on this environmentally sensitive area and on one of the premier waterways of central Texas.

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MBR Advantages

Advantages of Membrane Bioreactor (MBR) Technology Over Conventional Aerobic Treatment

- **MBR Effluent Is Reuse Water Quality**
  - Effluent quality: <5 mg/l BOD, <5 mg/l TSS, <5 mg/l TN, <1 mg/l TP
- **Reduced Plant Footprint**
  - Aeration and clarification stages combined in single basin
  - High MLSS concentrations permit higher plant loadings
- **Reduced Sludge Production**
  - Long SRT (>30 days) results in reduced net sludge generation
  - 0.4 lb sludge/lb BOD removed
- **Reduced Disinfection Capacity Required**
  - Membrane effective pore size is 0.1 micron (microfiltration)
  - Greater than 6 log bacteria and 3 log virus removal
  - Up to 90 percent reduction in UV disinfection capacity
- **Simultaneous Biological Nutrient Removal**
  - Nitrogen and Phosphorus removal possible within the standard MBR process

Advantages of the Enviroquip MBR System Over Hollow-Fiber Membrane Technologies

- **Technology Developed Specifically for Wastewater Treatment**
  - Kubota membranes designed for wastewater treatment service, not adapted from water treatment
- **Reduced Maintenance**
  - Systems run virtually unattended due to reduced cleaning requirements
- **In-situ Cleaning of Membranes**
  - Membranes are cleaned in place in 1-2 hours, resulting in short downtime
- **Fewer Annual Cleanings**
  - Only two annual cleanings required
- **No Air or Water Backflushing Required**
  - Membranes are continuously cleaned by continuous air scour
- **Gravity or Suction/Pressure Operation**
  - Enviroquip's MBR system can be designed for gravity or suction operation
- **Simultaneous Nitrification/Denitrification with SymBio™ Process**
  - Simultaneous Nitrification/Denitrification can be achieved using Enviroquip's patented SymBio™ process in combination with the MBR system

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